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California 94701

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Site Index Curves for Young-Growth Incense-Cedar of the Westside Sierra Nevada

K. Leroy Dolph

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Site index curves, an accepted index of timber productivity, were developed for young-growth incense-cedar. Stem analysis data were collected from 56 trees growing in mixed-conifer stands of the westside Sierra Nevada of California. Reference age is 50 years at breast height. Site index curves at 10-ft (3-m) intervals for breast-height ages of 10 to 80 years are provided for approximate field estimates. For more precise estimates, regression coefficients for each year and the equation for estimating site index are given.

Retrieval Terms: site index, increment (height), stem analysis, incense-cedar, *Libocedrus decurrens*, Sierra Nevada

Incense-cedar (*Libocedrus decurrens* Torr.) is widely distributed throughout the mixed-conifer forests of California and southwestern Oregon. The species grows on a diversity of sites ranging from arid ridgetops to moist streamsides, from low to high elevations, and from deep soils to shallow pockets of pulverized rock.[1] Until recently, incense-cedar has been considered a noncommercial timber species. Since the gold rush period of the 1850's, heavy selective logging has favored cutting of the other mixed-conifer species in the Sierra Nevada, mainly ponderosa pine (*Pinus ponderosa* Dougl. ex Laws.), sugar pine (*P. lambertiana* Dougl.), Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco) and, to a lesser extent, California white fir (*Abies concolor* [Gord. & Glend.] Lindl.).

More than a century of selective cutting, combined with a fire-exclusion policy, has resulted in a mixed-conifer forest with a much higher proportion of California white fir and incense-cedar than existed in the original stands. Fortunately, industry is now utilizing these previously undesirable species and, currently, the value of young-growth sawtimber is becoming the same for all species.[2]

Site index curves, which are used to estimate relative site potentials by the relationship of tree height to age, were developed for second-growth mixed-conifer stands of the Sierra Nevada nearly 50 years ago.[3] These curves, applicable to ponderosa pine, sugar pine, California white fir, and Douglas-fir, are a widely accepted index to timber productivity throughout the mixed-conifer forests of California. No similar index has been developed for incense-cedar, however.

With the changing emphasis on incense-cedar, a once undesirable species now being managed and even artificially regenerated to produce commercial timber products, the need for a reliable index of site potential for this species is apparent. An estimate of the productive capacity or site quality of an area, for a given species, enters into nearly every phase of forest management from regeneration to final harvest. Without the means to achieve this estimate, the forest manager is handicapped.

This note provides site index curves and a height growth equation applicable to young-growth incense-cedar growing in mixed-conifer stands on the westside Sierra Nevada of California. The methods used in curve derivation are given, and procedures for applying the curves are described. The site index curves are used to determine an index to potential production from current height and age. The height growth equation is used for describing

the development of height growth as a function of age and site index in the construction of yield tables.

METHODS

Stand and Sample Tree Characteristics

Young-growth natural stands that fit the definition given for the Sierra Nevada Mixed Conifer Type[4] were randomly sampled throughout the westside Sierra Nevada as part of a larger growth and yield study serving timber management needs in California.[5] Young-growth stands were defined as those in which more than 75 percent of the trees were 80 years old or younger at breast height. Ages of all trees on five sample plots within a stand were determined from increment cores. Plots were variable radius prism plots that used wedge prisms with basal area factors of 10, 20, 40, or 60, depending upon the stand composition. Most of the stands of mixed-conifer are uneven-aged (composed of two to many age classes); however, each stand is typically composed of even-aged groups, each with one main age class. At each sample plot one main age class could be identified and, except for occasional trees, maximum age differences were 10 to 20 years.

Selection of sample trees within each even-aged group was based on the characteristics of each individual tree. Crown position and percent of live crown were considered primary factors for indicating a tree's ability to express growth potential of a given site.

At each sample point, from 4 to 10 randomly selected trees were felled and sectioned for stem analysis. All mixed-conifer species were sampled in proportion to their abundance at each sample site. Stems were analyzed on 204 incense-cedar trees throughout the study area. Because all trees were selected randomly, only some were suitable for use in preparing the site index curves. Suitable trees had these characteristics:

- Dominant or codominant crown position, and apparently so throughout the course of their development. A group of narrow annual rings, indicating stress in the past, was cause for rejection.
- Not visibly infected with disease or insects.
- No broken or deformed tops visible and stem analysis indicated no top damage in the past.
- Crown ratios at least 40 percent. Height growth of trees with lower crown ratios may have been adversely affected by increasing densities.
- Age at breast height at least 50 years.

Data Collection

Stem analysis data from 56 incense-cedar trees that met the five criteria

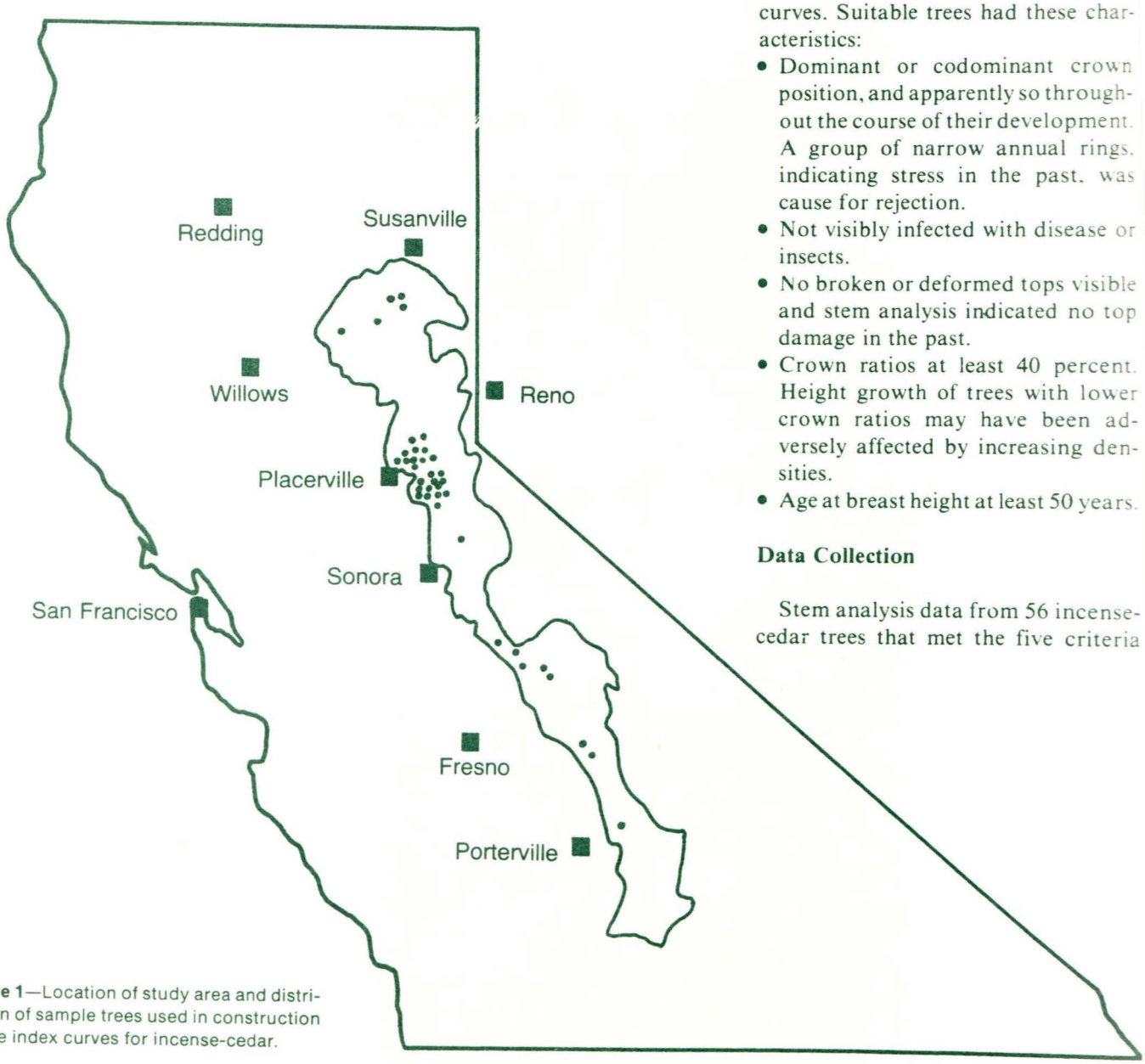

Figure 1—Location of study area and distribution of sample trees used in construction of site index curves for incense-cedar.

were collected on 55 prism plots (one plot had two suitable site trees) in the Sierra Nevada, with a concentration of samples from the center of the range (*fig. 1*).

Each tree was marked at breast height (4.5 ft [1.4 m] above the ground on the uphill side of the tree) before felling. All subsequent height measurements were taken from this reference point. Height to the tip of the tree was first recorded. Height of the tree when growth started 10 years earlier was next determined by cutting cross sections down the stem until the lowest section that contained 10 complete growth rings was found. Height to this section was then recorded. This procedure was repeated for the 20-year section. Rings were counted at additional cross sections taken at breast height (b.h.), 5.25 and 10.5 ft (1.6 and 3.2 m) above b.h., and 18.5-ft (5.6-m) intervals up the stem to the 20-year section.

Height-Age Curves

The breast-height age of each tree when its height had reached each sectioning point was determined by subtracting the ring count at each respective section from the present b.h. age. The height above b.h. of each section was plotted over b.h. age for each of the 56 trees. The points for each tree were connected with smoothed curves. Heights were read from these curves for b.h. ages 10 to 75 years at 5-year intervals. These heights and ages were used in the subsequent analysis. Heights for ages over 75 years were eliminated from further analysis because the older age classes were inadequately represented. From this point, the methods outlined by Barrett and Cochran were used to construct the site index curves.[6]

Age at breast height, rather than total age, was selected as the independent variable for use in the construction of the height-age curves because not only is it more convenient to use, but represents a height characteristic of species that have passed through their period of initial establishment. It also eliminates the need to add on a flat correction factor to obtain total age.[7]

CONSTRUCTION OF SITE INDEX CURVES

A site index estimating equation of the form

$$\text{Site index} = f(\text{height, age})$$

can be developed from stem analysis data because an estimate of site index is available in the form of measured heights of the sample trees at the chosen reference age, in addition to heights at other ages.[8] For a specified age, therefore,

$$\text{Site index} = f(\text{height}).$$

Total height at b.h. age 50 was arbitrarily called the site index for each tree. A linear regression line was then calculated for the relationship of site index to height for each 5-year interval starting with 10 years and ending with 75 years. Plotting of the data indicated that only a straight line was appropriate for each age (*table 1*). The basic equation for these regressions is

$$SI - 4.5 \text{ ft} = a + b\,(H - 4.5 \text{ ft}) \qquad (1)$$

in which

SI = site index in feet,
H = total height in feet,
and, a and b are regression parameters estimated by least squares.

A common origin at b.h. for the height, age, and site index scales is obtained by subtracting 4.5 ft.

The b coefficients for the 14 regressions, which express the relationship of site index to height at each age interval, were then plotted over age and a smooth progression of b values resulted (*fig. 2*). Nonlinear regression was used to fit a smooth curve to the plotted points. The estimates of b were smoothed over age by the equation

$$\hat{b} = 0.206271 - 0.000617\,(\text{age}) + \frac{45.954649}{\text{age} + 5.731439}$$

forced through a value of b = 1 at b.h. age of 50 years.

A curve of average height as a function of b.h. age was constructed next. Individual regressions for each 5-year interval of age, which express height as a function of site index (*table 2*), were made using the equation

$$H - 4.5 \text{ ft} = a_1 + b_1\,(SI - 4.5 \text{ ft}) \qquad (2)$$

At ages beyond 50 years, the sample became progressively smaller and mean site index was slightly different. Average heights for these older ages were adjusted to the mean overall site index with the a_1 and b_1 values of the individual regressions by the equation

$$\overline{HT} - 4.5 \text{ ft} = a_1 + b_1\,(\overline{SI} - 4.5 \text{ ft})$$

in which

Table 1—*Statistics for separate regressions of SI - 4.5 ft = a + b (HT - 4.5 ft) for each indicated age for young-growth incense-cedar of the westside Sierra Nevada*

Breast-height age (years)	a	b	r^2	Standard error of the estimate (SE) (feet)	Observations
10	18.1521	3.1213	0.5684	9.8513	56
15	13.2795	2.4239	.7063	8.1267	56
20	9.7243	1.9855	.8066	6.5936	56
25	7.1888	1.6682	.8746	5.3098	56
30	5.0481	1.4516	.9239	4.1359	56
35	3.0692	1.3025	.9554	3.1683	56
40	1.5401	1.1825	.9794	2.1504	56
45	.3503	1.0886	.9945	1.1145	56
50	0	1	1	0	56
55	0.1707	0.9198	0.9953	1.0006	42
60	.3654	.8498	.9839	1.7278	35
65	.9722	.7992	.9839	1.9291	27
70	.6158	.7699	.9715	2.4038	18
75	.9487	.7078	.9641	2.4138	10

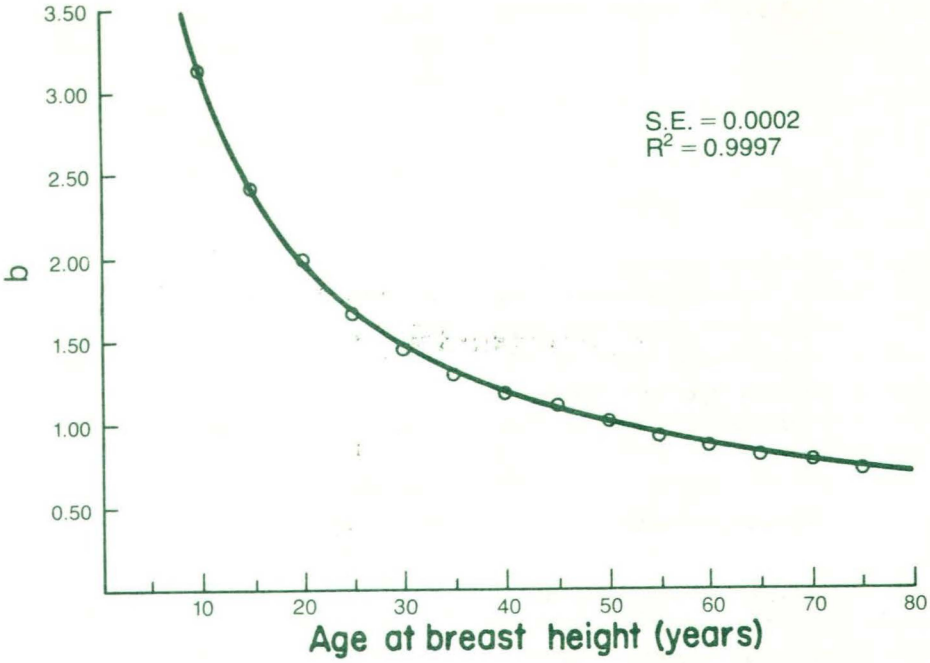

Figure 2—b values in equation SI - 4.5 ft = a + b (HT - 4.5 ft) as a function of age. Plotted points are actual b values. Solid line is the curve expressed by the equation

$$\hat{b} = 0.206271 - 0.000617 \text{ (age)} + \frac{45.954649}{\text{age} + 5.731439}$$

Table 2—*Statistics for separate regressions of HT - 4.5 ft = a_1 + b_1 (SI - 4.5 ft) for each indicated age for young-growth incense-cedar of the westside Sierra Nevada*

Breast-height age (years)	a_1	b_1	r^2	Standard error of the estimate (SE) (feet)	Observations	Adjusted average[1] HT - 4.5 ft
10	0.2827	0.1821	0.5684	2.3794	56	8.31
15	- .1346	.2914	.7063	2.8176	56	12.71
20	- .6030	.4063	.8066	2.9826	56	17.31
25	- .9945	.5243	.8746	2.9766	56	22.13
30	-1.1664	.6365	.9239	2.7387	56	26.90
35	- .8449	.7335	.9554	2.3775	56	31.50
40	- .5354	.8283	.9794	1.7998	56	35.99
45	- .0979	.9135	.9945	1.0210	56	40.19
50	0	1	1	0	56	44.10
55	0.0289	1.0821	0.9953	1.0853	42	47.75
60	.3377	1.1578	.9839	2.0167	35	51.40
65	- .3769	1.2311	.9839	2.3942	27	53.91
70	.7352	1.2618	.9715	3.0772	18	56.38
75	.6016	1.3621	.9641	3.3485	10	60.67

[1]Adjusted HT - 4.5 ft = a_1 + b_1 (44.10).

$\overline{HT}$ = adjusted average height, and the mean overall site index of the 56 samples ($\overline{SI}$) equals 48.6 ft.

$\overline{HT}$ - 4.5 ft was then plotted over age for each 5-year interval. Estimates of $\overline{HT}$ were smoothed over age by the equation

$$\hat{HT} - 4.5 \text{ ft} = e^{[-1.051513 + 1.36553 (\log_e \text{age}) - 0.002152 (\log_e \text{age})^2]}$$

forced through the mean site index (48.6 ft) at 50 years (*fig. 3*), in which $\hat{HT}$ is the estimate of adjusted average height.

$\hat{HT}$ and $\hat{b}$ values for each year were then used to calculate the corresponding intercept a. According to the principle of least squares, the best estimate of this coefficient is[9]

$$a = \overline{Y} - b\overline{X}$$

In this situation, the best estimate of a is

$$\hat{a} = (\overline{SI} - 4.5 \text{ ft}) - \hat{b}(\hat{HT} - 4.5 \text{ ft})$$

Estimates of a and b for each year are given (*table 3*).

EQUATION FOR ESTIMATING SITE INDEX

Substituting the appropriate expressions for $\hat{a}$, $\hat{b}$, and $\hat{HT}$ in equation 1 gives the final equation used to estimate site index as a function of b.h. age and total tree height (*table 4*).

$$\hat{SI} = 48.6 - [e^{[-1.051513 + 1.36553 (\log_e \text{age}) - 0.002152 (\log_e \text{age})^2]}] \left(0.206271 - 0.000617 \text{ age} + \frac{45.954649}{\text{age} + 5.731439}\right) + (H - 4.5 \text{ ft}) \left(0.206271 - 0.000617 \text{ age} + \frac{45.954649}{\text{age} + 5.731439}\right) \quad (3)$$

Equation 3 can be used to obtain precise estimates of site index when b.h. age and total tree height are known. For hand-held calculators, a precise estimate can also be obtained by solving equation 1 with the appropriate a and b values (*table 3*) and the measured total tree height, H.

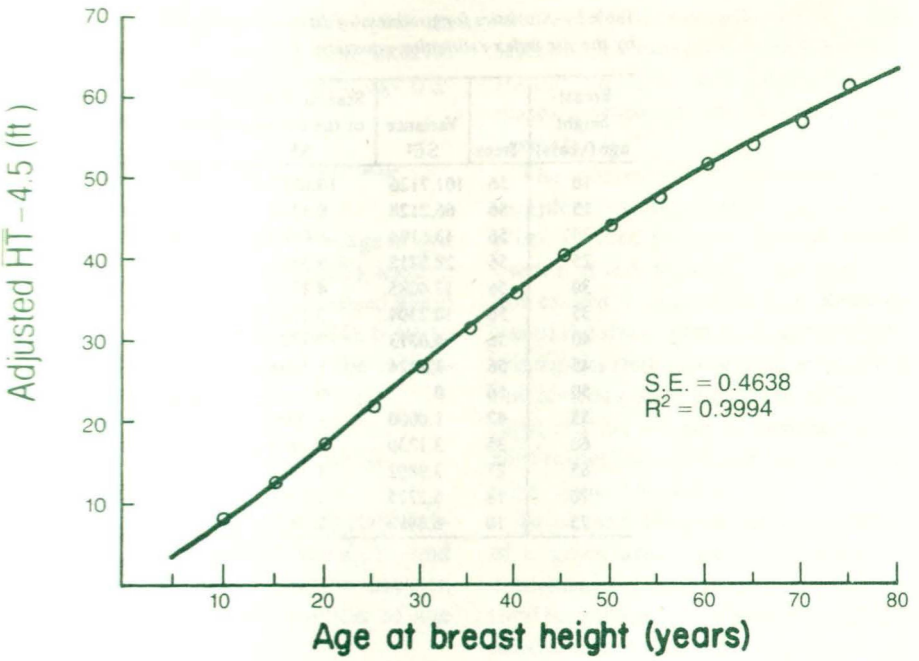

Figure 3—Average height as a function of age. Plotted points are average heights - 4.5 ft. Solid line is curve expressed by the equation

$$\hat{HT} - 4.5 \text{ ft} = e^{[-1.051513 + 1.36553 (\log_e \text{age}) - 0.002152 (\log_e \text{age})^4]}$$

Table 4—*Site index values of young-growth incense-cedar of the westside Sierra Nevada, by height and breast-height age class*

Total height (feet)	Breast-height age (years)														
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
	Site index (feet)														
10	41.9	31.6	24.7	20.0	16.5	14.1	12.3	10.9	10.0						
20	73.2	55.7	44.5	36.8	31.3	27.2	24.1	21.8	20.0	18.7	17.6	16.9	16.4	16.1	15.9
30	.....	79.8	64.3	53.7	46.0	40.3	36.0	32.6	30.0	27.9	26.3	25.1	24.1	23.4	22.8
40	.....	.....	84.1	70.5	60.8	53.5	47.8	43.5	40.0	37.2	35.0	33.2	31.8	30.6	29.7
50	.....	.....	.....	87.4	75.5	66.6	59.7	54.3	50.0	46.5	43.7	41.4	39.5	37.9	36.7
60	.....	.....	.....	.....	90.2	79.7	71.6	65.2	60.0	55.8	52.4	49.5	47.2	45.2	43.6
70	.....	.....	.....	.....	.....	92.8	83.4	76.0	70.0	65.1	61.1	57.7	54.9	52.5	50.5
80	.....	.....	.....	.....	.....	.....	95.3	86.8	80.0	74.4	69.7	65.9	62.6	59.8	57.5
90	.....	.....	.....	.....	.....	.....	.....	97.7	90.0	83.7	78.4	74.0	70.3	67.1	64.4
100	.....	.....	.....	.....	.....	.....	.....	.....	93.0	87.1	82.2	78.0	74.4	71.3	
110	.....	.....	.....	.....	.....	.....	.....	.....	.....	95.8	90.3	85.7	81.7	78.2	
120	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	93.4	89.0	85.2
130	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	96.3	92.1

Table 3—*Values for a and b, by years, for estimating site index[1] for young-growth incense-cedar of the westside Sierra Nevada*

Breast-height age (yrs)	Years between decades																			
	0		1		2		3		4		5		6		7		8		9	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
10	20.2808	3.1213	18.7643	2.9461	17.3670	2.7906	16.0772	2.6516	14.8843	2.5266	13.7794	2.4137	12.7543	2.3111	11.8020	2.2174	10.9163	2.1316	10.0916	2.0527
20	9.3230	1.9799	8.6061	1.9124	7.9369	1.8498	7.3120	1.7915	6.7281	1.7371	6.1823	1.6862	5.6720	1.6385	5.1949	1.5936	4.7487	1.5514	4.3315	1.5115
30	3.9414	1.4739	3.5769	1.4382	3.2363	1.4044	2.9184	1.3724	2.6216	1.3419	2.3450	1.3129	2.0872	1.2853	1.8475	1.2589	1.6246	1.2337	1.4179	1.2096
40	1.2263	1.1865	1.0493	1.1644	.8859	1.1431	.7356	1.1228	.5978	1.1032	.4717	1.0844	.3569	1.0662	.2529	1.0488	.1591	1.0319	.0751	1.0157
50	.0004	1.0000	-.0654	.9848	-.1227	.9702	-.1718	.9560	-.2130	.9423	-.2469	.9290	-.2735	.9162	-.2933	.9037	-.3065	.8916	-.3135	.8798
60	-.3143	.8684	-.3094	.8573	-.2989	.8465	-.2830	.8360	-.2620	.8258	-.2361	.8159	-.2054	.8062	-.1701	.7968	-.1304	.7876	-.0866	.7786
70	-.0386	.7699	.0132	.7614	.0688	.7531	.1281	.7449	.1908	.7370	.2569	.7292	.3262	.7217	.3987	.7142	.4741	.7070	.5525	.6999
80	.6336	.6930																		

[1]To estimate site index, measure total height of suitable site tree. Determine breast-height age from increment core. Select appropriate a and b values above. Substitute values in the equation SI -4.5 ft = a + b (total height - 4.5 ft); for example, for a tree 47 years old at breast height and 60 ft in total height, solve the equation SI - 4.5 ft = 0.2529 + 1.0488 (60 - 4.5 ft), for a site index of 62.96.

To determine the precision of site index estimates made from equation 3, differences between actual site index (SI) and predicted site index ($\hat{SI}$) were calculated from the heights of each tree at each 5-year age interval (data from the original height-age curve for each tree).

The residual sum of squares at each 5-year interval was calculated by summing the squares of these differences in which

$$\text{residual SS} = \Sigma(SI - \hat{SI}) = \Sigma (SI - a - bH)$$

The mean square deviation from regression, SE^2, which is the estimate of the variance of the errors, was calculated by

$$SE^2 = \frac{\text{residual SS}}{n - 2}$$

in which n = number of observations and 2 = degrees of freedom, or the number of estimated coefficients used in fitting the regression at that age (a and b) (*table 3*). The sample standard deviation from regression, SE, also called the standard error of the estimate, is the square root of the variance of the errors

$$SE = \sqrt{SE^2}$$

The estimate of the variance, the standard error of the estimate, and the coefficient of determination (R^2), for each 5-year age interval are only approximate because the $\hat{a}$ and $\hat{b}$ values for each age are themselves estimated values of a and b (*table 5*).

As is to be expected with any set of site curves, the estimates become more precise as tree age approaches index age. At age 35, all the estimates are within 10 ft of actual site index. At 10 years, 68 percent of the estimates are within 10 ft of actual site index.

EQUATION FOR ESTIMATING HEIGHT GROWTH

Estimates of future height growth of dominant and codominant trees in stands of a given site quality can be developed from equation 2. To obtain

Table 5—*Statistics for goodness-of-fit of site index curves generated by the site index estimating equation*

Breast-height age (years)	Trees	Variance SE^2	Standard error of the estimate SE	Coefficient of determination R^2
10	56	101.7126	10.0853	0.5392
15	56	66.2128	8.1371	.7001
20	56	43.8194	6.6196	.8015
25	56	28.5715	5.3452	.8706
30	56	17.4085	4.1724	.9211
35	56	10.2304	3.1985	.9537
40	56	4.6313	2.1520	.9790
45	56	1.2424	1.1146	.9944
50	56	0	0	1
55	42	1.0000	1.0000	.9952
60	35	3.1230	1.7672	.9826
65	27	3.9892	1.9973	.9821
70	18	6.2775	2.5055	.9671
75	10	6.1888	2.4877	.9571

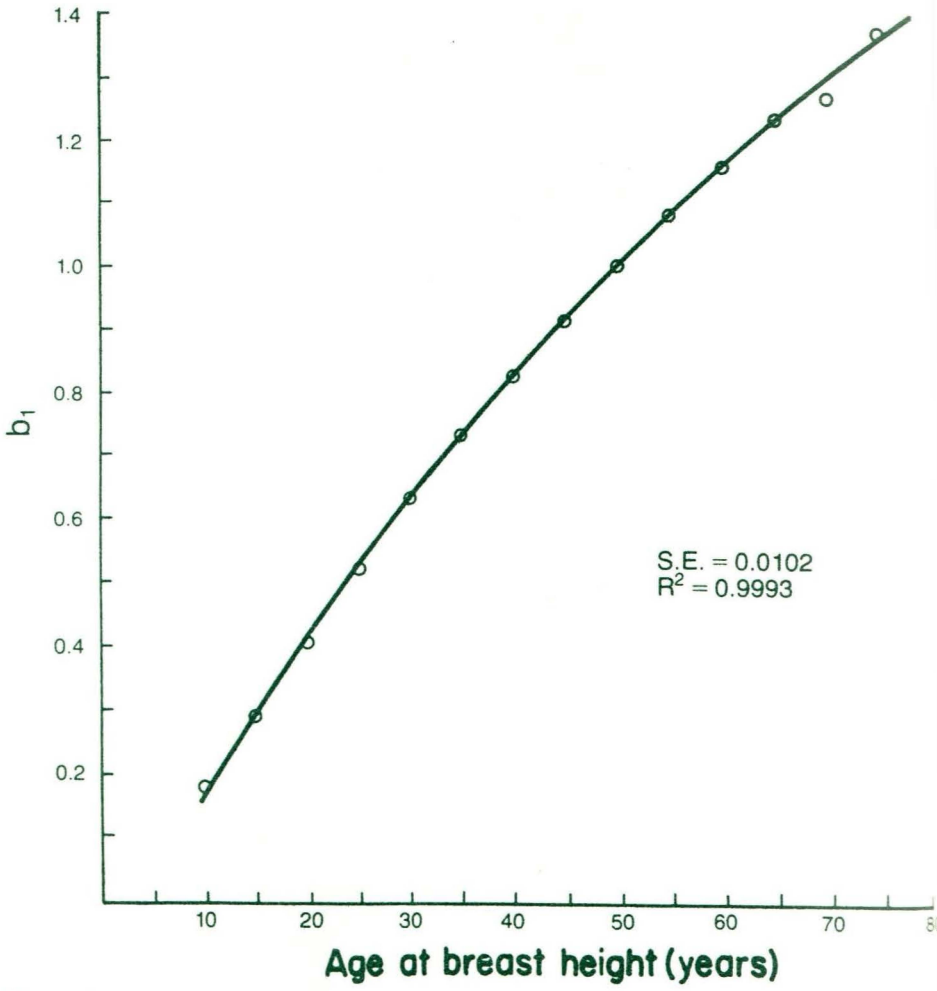

Figure 4—b_1 values in equation HT - 4.5 ft = $a_1 + b_1$ (SI - 4.5 ft) as a function of age. Plotted points are actual b_1 values. Solid line is curve expressed by the equation

$$\hat{b}_1 = 2.405395 - 2.505796\, e^{-0.011566\, age}$$

coefficient estimates for this equation, the b_1 values for each 5-year interval (*table 2*) were smoothed over age (*fig. 4*) by the equation

$$\hat{b}_1 = 2.405395 - 2.505796\, e^{-0.011566\, age}$$

The same expression for average height as a function of b.h. age ($\hat{HT}$), used in determining site index, was used again with the mean site index (48.6 ft) to obtain an expression for the corresponding intercept a_1, in which

$$\hat{a}_1 = \hat{HT} - 4.5\text{ ft} - \hat{b}_1\,(\overline{SI} - 4.5\text{ ft})$$

Rearrangement and appropriate substitution of expressions for $\hat{a}_1$, $\hat{b}_1$, and $\hat{HT}$ give the final equation used to estimate height as a function of age and site index

$$\hat{H} = 4.5\text{ ft} + e^{[-1.051513 + 1.36553(\log_e age) - 0.002152(\log_e age)^2]} + (2.405395 - 2.505796\, e^{-0.011566\, age})\,(SI - 48.6\text{ ft}) \qquad (4)$$

Precise estimates of height for a given age and site index can be obtained from equation 4. Height estimates from this equation are given by site index and b.h. age classes (*table 6*).

APPLICATION

The site index curves for incense-cedar apply to mixed-conifer forests of the westside Sierra Nevada. When the forest is composed of recognizable even-aged groups perpetuated by group selection, careful selection of site trees should produce consistent site estimates, comparable to those in even-aged stands.[10]

The curves were developed from sample trees on variable radius prism plots. If fixed radius sample plots are used, it is recommended that plots do not exceed 1/5 acre (0.08 ha). Regardless of the size of plot used, the primary criterion is that all site trees selected in one area are growing on the same site type; that is, the site is homogeneous with respect to stand composition, soil type, slope, and aspect.

To estimate the productive potential of a given area, site index must be determined from measurements of total height and age at breast height for selected trees that meet the following specifications:

- Young-growth—at least 10 years and not over 80 years old at breast height.
- Crown position dominant or codominant and appears to have been so throughout the course of its development.
- Visibly free of insects and disease.
- No top damage, no broken or deformed top, such as crooks, scars, or forks.
- Crown ratio at least 40 percent.
- Increment core taken at breast height should show no fire scars, mechanical damage, nor any period of suppression followed by release.

The site index value for each sample tree can be estimated from the curves (*figure 5*) or the tabular values (*table 4*). For computer or calculator applications, either the site index estimating equation (3) or the basic site index equation (1) with appropriate a and b values (*table 3*) can be used.

The number of sample trees necessary to give any stated precision of estimate will depend on the variance in site index between trees in a given area. This variance is influenced by the size of the area and the degree of its heterogeneity in site quality. A formula for determining the required number of sample trees is provided by Arvanitis and others.[11]

The average site index for all sample trees is the best estimate of average site index for the area sampled if selection of site trees is random with respect to site quality.

Site indexes calculated with trees with b.h. age greater than 75 years should be used with caution because such estimates are made with extrapolations of the basic data.

NOTES

[1]McDonald, Philip M. *Incense-cedar—an American wood.* FS-226. Washington, DC: U.S. Department of Agriculture, Forest Service; 1973 October. 7 p.

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Table 6—*Estimated heights of dominant and codominant trees where site index and breast-height (b.h.) age are known for young-growth incense-cedar of the westside Sierra Nevada*

Site index (feet)	Breast-height age (years)														
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
	Total height (feet)														
10	5.4	5.5	6.0	6.6	7.3	8.0	8.7	9.4	10.0	10.6	11.1	11.6	12.0	12.4	12.7
20	7.2	8.5	10.1	11.9	13.6	15.3	17.0	18.5	20.0	21.4	22.7	23.8	24.9	25.9	26.8
30	8.9	11.5	14.3	17.2	19.9	22.7	25.2	27.7	30.0	32.2	34.2	36.1	37.8	39.5	41.0
40	10.6	14.5	18.5	22.4	26.3	30.0	33.5	36.9	40.0	43.0	45.7	48.3	50.7	53.0	55.1
50	12.4	17.5	22.6	27.7	32.6	37.3	41.8	46.0	50.0	53.7	57.3	60.6	63.6	66.5	69.2
60	14.1	20.5	26.8	33.0	39.0	44.7	50.1	55.2	60.0	64.5	68.8	72.8	76.5	80.0	83.3
70	15.8	23.5	31.0	38.3	45.3	52.0	58.3	64.3	70.0	75.3	80.3	85.0	89.4	93.6	97.4
80	17.6	26.4	35.2	43.6	51.7	59.3	66.6	73.5	80.0	86.1	91.9	97.3	102.3	107.1	111.6
90	19.3	29.4	39.3	48.9	58.0	66.7	74.9	82.7	90.0	96.9	103.4	109.5	115.2	120.6	125.7

Figure 5—Site index curves for young-growth incense-cedar of the westside Sierra Nevada.

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The Author:

K. LEROY DOLPH, a research forester assigned to the Station's Silviculture of Sierra Nevada Conifer Types research unit in Redding, Calif., received a B.S. degree (1969) in forest management and an M.S. degree (1971) in forest ecology from Colorado State University.